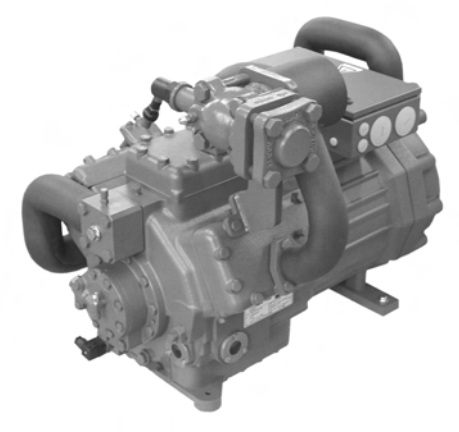
BOCK COMPRESSORS



HGZ7

Operating instructions

Types:

HGZX7/1620-4 R404A/R507
HGZX7/1620-4 R410A
HGZ7/1620-4 R22

HGZX7/1860-4 R404A/R507
HGZX7/1860-4 R410A
HGZ7/1860-4 R22

HGZX7/2110-4 R404A/R507
HGZX7/2110-4 R410A
HGZ7/2110-4 R22

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GB
F

Foreword

Dear Customer,

Bock compressors are top-quality, reliable, service-friendly quality products. Please comply with the following operating and maintenance instructions so that you can benefit from all advantages to the full and use your refrigerating system throughout its entire service life. If you have any questions about installation, operation and accessories, please contact our technical service or your refrigerating system wholesale dealer or our representative. The Bock service team is available by phone under +49 7022 9454-0, by e-mail under mail@bock.de or on the internet under www.bock.de. In addition, for German speaking countries we have set up a toll-free hotline under 00 800 / 800 000 88 from Monday to Saturday between 8 a.m. and 9 p.m. Any suggestions you may have regarding the on-going development of our compressor, equipment and parts programme are welcome at any time.

QUALITY SYSTEM

certified by DQS according to DIN EN ISO 9001 Reg. No. 2177

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Please read the information summarised for you in this manual before starting work.

It contains important instructions for safety, installation, initial commissioning and handling. In addition you will find information on maintenance, spare parts and accessories.

Some instructions are identified by special symbols with the following meaning:

WARNING! This symbol is used to indicate that inaccurate compliance or total failure to comply with the instructions could cause injury to persons or damage to the compressor or refrigerating machine

DANGER! This symbol refers to instructions for avoiding direct severe dangers to persons.

DANGER! This symbol refers to instructions for avoiding direct severe dangers to persons or plant by electrical current.

This symbol indicates important additional instructions which you should observe during your work.

The high quality standard of Bock compressors is guaranteed also by on-going further development of machine, features and accessories. This could possibly result in nonconformities between this present manual and your compressor. Please understand that it is not possible for any claims to be derived from the details, illustrations and descriptions.

Your team at
Bock Kältemaschinen GmbH

- Subject to modifications -

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Safety instructions

The Bock refrigerating compressors named in the title are intended for installation in machines (within the EU according to EU directive 98/37/EC Machinery Directive, 97/23/EC Pressure Equipment Directive and 73/23/EC Low Voltage Directive). Initial commissioning is only allowed when the compressor has been installed according to these instructions and the whole machine in which it is integrated has been tested and accepted according to the statutory regulations.

Bock refrigerating compressors have been designed to state-of-the-art engineering. Safety for the user is given particular priority during the design stage. However, it is always possible for the refrigerating machine and operation thereof to pose unavoidable residual risks. This is why these instructions must be observed carefully by every person working at the compressor.

Work on the compressor may only be carried out by persons whose technical training, skills and experience together with their knowledge of pertinent regulations and documentation means that they are capable of assessing the work to be carried out and detecting any possible dangers

Safety instructions

- Any handling of the compressor is permissible only by skilled personnel!
- Observe national safety regulations, accident prevention regulations, generally recognized technical rules as well as specific regulations (EN 378, EN 60204, EN 60355 etc.).
- Carry compressors only with hoists with sufficient lifting power.
- Operate compressors only in refrigeration plants with approved refrigerants.
- Do not exceed permissible operating pressure – even for testing purposes.
- Caution! Compressors are filled with protective gas ex works (approx. 3 bar nitrogen). Avoid possible injuries to skin and eyes! Wear goggles! Relieve pressure of compressors before connection to the refrigeration system!
- Before start-up check compressor for transport damage.
- Before start-up check that all components mounted by the user are installed correctly and connected pressure-tight with the compressor (pipes, plugs, union nuts, replaced components etc.).
- Before start-up evacuate the refrigeration plant with compressor carefully and then charge with refrigerant.
- Open discharge and suction shutoff valves before starting the compressor.
- Do not start the compressor in vacuum! Operate only with refrigerants charge.
- Corresponding to the conditions of use, surface temperatures of more than 100 °C on the discharge side and below 0 °C on the suction side can be reached.

Product description

Models available

1. Standard design: Compressor with intermediate-pressure line mounted and insulated. Liquid subcooler, expansion valve, solenoid valve, filter drier and two sight glasses enclosed separately, for individual, external mounting.
2. Optional design: Liquid subcooler, expansion valve, solenoid valve, filter drier and two sight glasses mounted directly to the compressor, piped and insulated.

Proper Use

BOCK refrigerating compressors are designed for use in cooling systems using the refrigerants specified below and in compliance with the operating limits. Only refrigerants specified on the name plate may be used.No other use of the compressor is permitted!

Warning!
Do not use in potentially explosive areas!

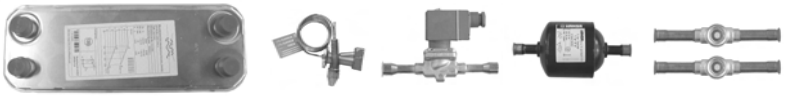
Short Description

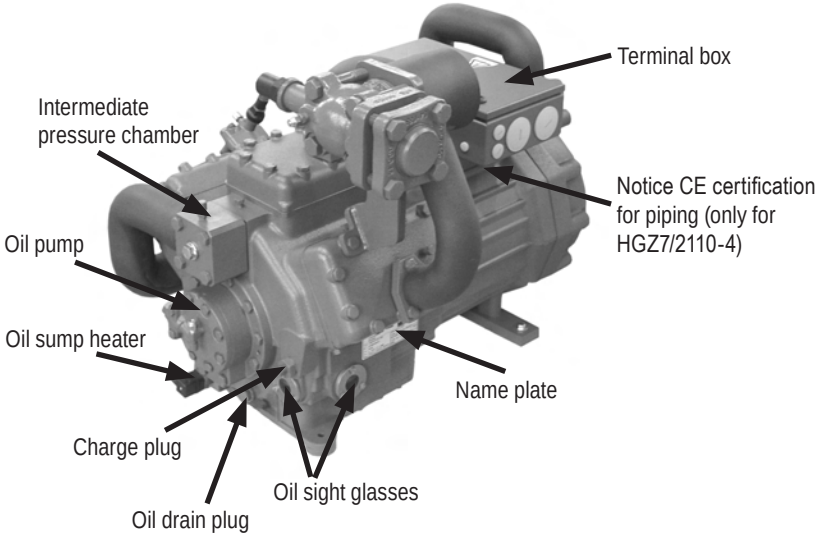
- Semi-hermetic, two-stage, six-cylinder reciprocating compressor with suction-gas-cooled drive motor.
- Stages divided into LP / HP at the ratio of 2 : 1
- Two-stage operation with liquid subcooler
- Expansion valve for subcooling adjusted for refrigerant and application range

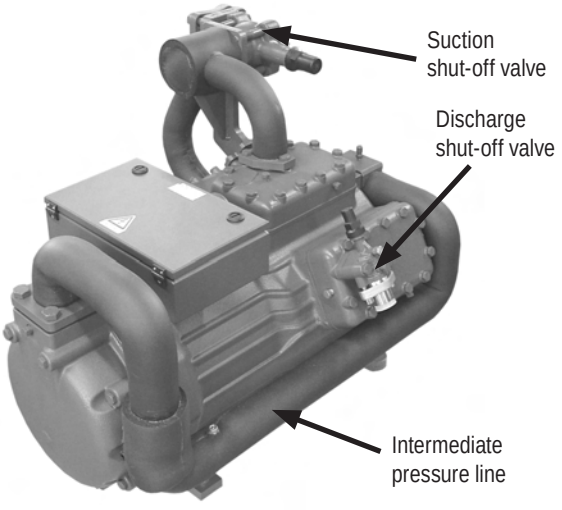
Product description

Main and functional parts (standard version)

Liquid subcooler, expansion valve, solenoid valve, filter drier and two sight glasses (ill., from left to right), enclosed separately for individual, external mounting.







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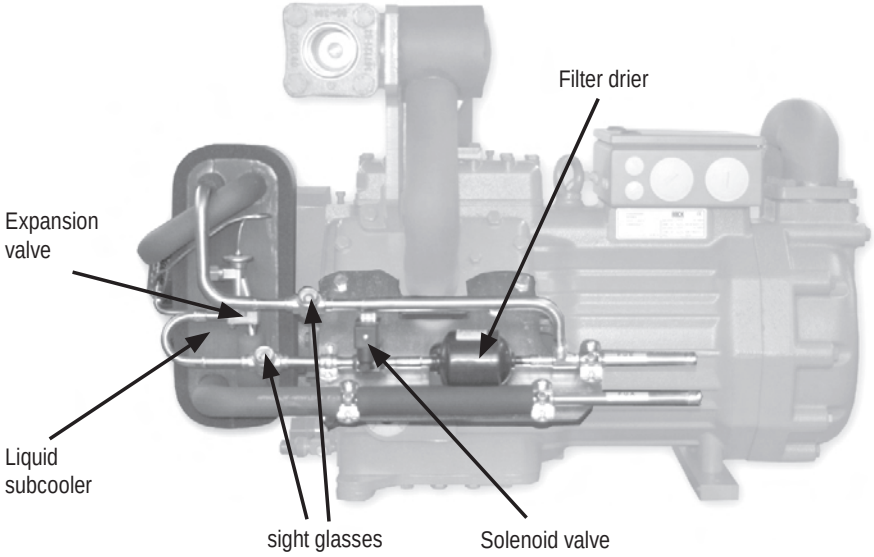
Product description

Main and functional parts (optional version)

Liquid subcooler, expansion valve, solenoid valve, filter drier and two sight glasses mounted directly to the compressor, piped and insulated.



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Product description

Name plate (example)

1 Type designation
2 Machine number
3 Maximum operating current
4 Starting current (rotor blocked)
Δ: Partial winding 1
YYY: Partial windings 1 and 2
5 ND (LP): Max. allowable standstill pressure
Suction side
HD (HP): Max. allowable operating pressure
High-pressure side

Observe operating limits diagrams!

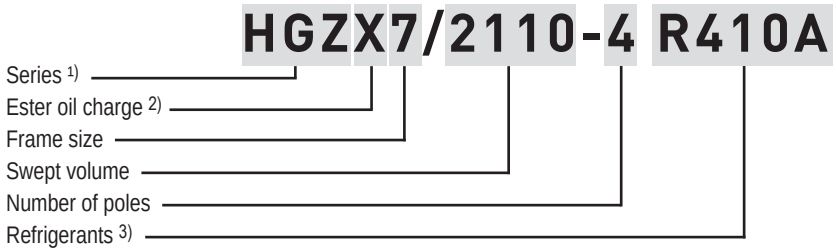
50 Hz
6 Voltage, connection, frequency
7 Nominal rotation speed
8 Displacement
$\dot{V}_{ND}$ = low pressure stage
$\dot{V}_{HD}$ = High-pressure stage

60 Hz
9 Voltage, connection, frequency
10 Nominal rotation speed
11 Displacement
$\dot{V}_{ND}$ = low pressure stage
$\dot{V}_{HD}$ = High-pressure stage

12 Oil type charged at factory
13 Protection class terminal box

Electrical accessories of the compressor can change the IP protective class

Type code (example)



1) HGZ = Hermetic gas cooled (suction gas cooled), two-stage
2) X = Ester oil filling (HFC refrigerant R404A/R507, R410A)
3) Possible alternative refrigerants R404A/R507, R410A, R22

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Areas of application

Refrigerants

- (H)CFC: R22
- HFC: R404A/R507, R410A

Oil charge

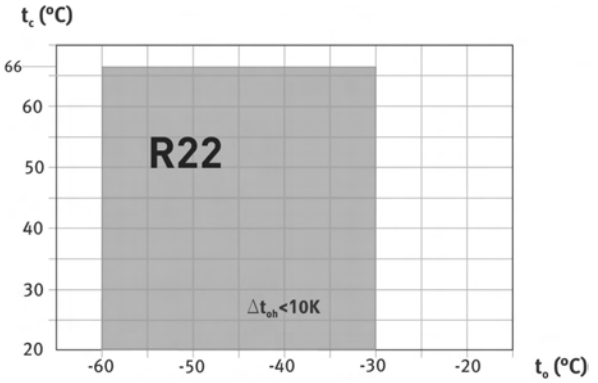
- The compressors are charged with the following oil types at the factory:
  for R22: FUCHS Reniso SP 46;
  for R404A/R507, R410A: FUCHS Reniso Triton SE 55.
  Compressors with ester oil filling (FUCHS Reniso Triton SE 55) are marked with an X in the type designation (e.g. HGZX7 / 2110-4 R410A)
- For charge, we recommend the above oil types. Alternatives: See extract from the Bock lubricants table p. 31.

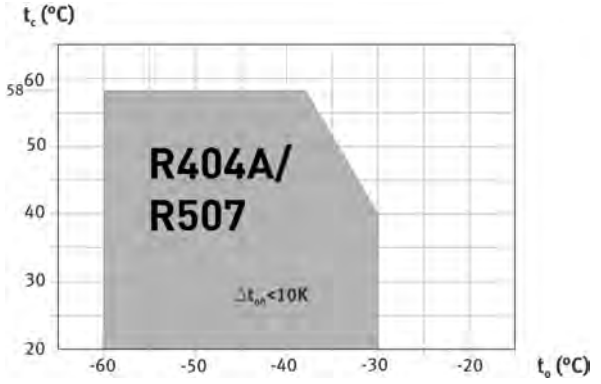
Operating limits

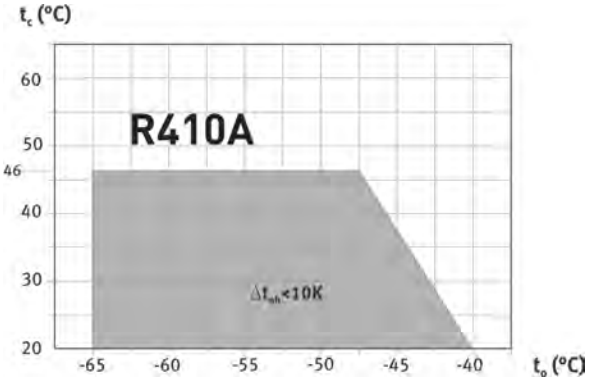
- The compressor may be operated within the range of the diagrams shown. Care must be taken to assign the refrigerant correctly. The operating limits must be observed! The maximum discharge end temperature of 140 °C must not be exceeded.
  - Use only oils that are highly thermally stable (see lubricants table)
  - Avoid continuous operation near the limits.
  - The expansion valve of the liquid subcooler is designed for the corresponding refrigerant (see name plate) and is set at the factory for the entire range of application. Subsequent adjustment is unnecessary.
- Do not exceed the compressor's maximum permissible switching frequency (12 switching cycles per hour)! The system must reach a steady state condition (continuous operation). Do not go below the minimum operating time of 3 minutes.

- During operation below ambient pressure, there is a danger of air entering on the suction side. This can cause chemical reactions, pressure rise in the condenser and an excessive pressure gas temperature as well as shifting of the refrigerant ignition limit into the critical range. Avoid absolutely any entry of air!

Areas of application







t_o evaporating temperature (°C)

t_c condensing temperature (°C)

Δt_{oh} suction gas superheat (K)

Unrestricted area of application

Design for other areas on request

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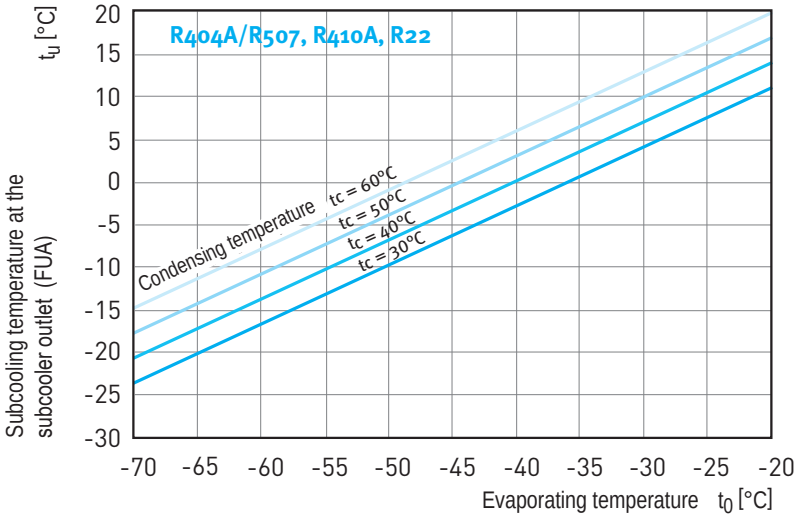
Areas of application



Subcooling temperature

The design of the expansion valve on the compressor can be defined with the help of the diagram by approximately calculating the subcooling temperature arising in the relevant operating conditions (t_0/t_c).

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Description of functions

The refrigerant suctioned out of the evaporator (21) is compressed by the 4 cylinders of the LP stage (2) to intermediate pressure MP. After that, the superheated refrigerant flows through the intermediate pressure chamber (3), where it is cooled by the liquid subcooler system to reduce the discharge end temperature. The refrigerant then flows through the intermediate pressure line (4) to the electric motor of the compressor for to cool the motor. After this, the refrigerant is suctioned in by the two HP cylinders (5) and compressed to the final pressure.

Liquid subcooler system

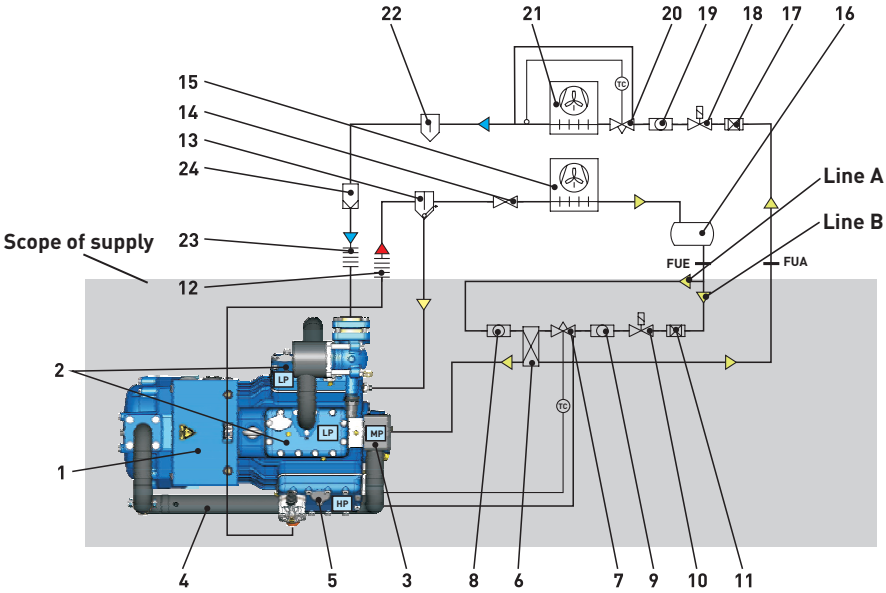
The liquid subcooler system consists of the components
- liquid subcooler (plate heat exchanger) (6)
- expansion valve (7)
- sight glasses (8, 9)
- solenoid valve (10)
- filter drier (11)

After the refrigerant reciever (16), the liquid line will be splitted into two lines:

Line A leads through the liquid subcooler (6) and the subcooled refrigerant flows to the evaporator (21). Through line B, refrigerant is expanding through the expansion valve (7) into the liquid subcooler (6) in order to subcool the refrigerant of line A. Afterwards the refrigerant of line B flows to the intermediate pressure chamber (MP) and through the intermediate pressure line (MP) to cool the superheated refrigerant, which is compressed from low pressure to intermediate pressure.

Description of functions

Two-stage refrigeration cycle with liquid subcooler



Explanations

1 Compressor
2 Cylinder LP-stage
3 Intermediate pressure chamber MP
4 Intermediate pressure line MP
5 Cylinder HP-stage
6 Liquid subcooler
7 Expansion valve
8 Sight glass
9 Sight glass
10 Solenoid valve
11 Filter drier
12 Damper, pressure line
13 Oil separator
14 Non-return valve
15 Condenser
16 Refrigerant receiver
17 Filter drier
18 Solenoid valve
19 Sight glass
20 Expansion valve (evaporator)
21 Evaporator
22 Liquid separator
23 Damper, suction line
24 Filter suction line

LP = Low pressure
MP = Intermediate pressure
HP = High pressure
FUE = Liquid subcooler, inlet
FUA = Liquid subcooler, outlet

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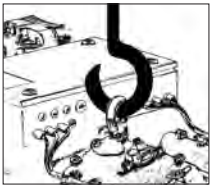
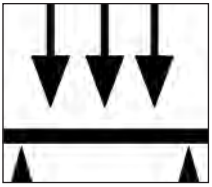
Installation

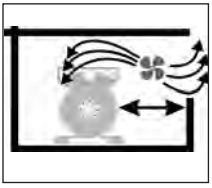
Setting up



- Use transport eyelet.
- Do not lift manually.
- Use lifting gear.



- Erect on a flat surface or frame with sufficient load-bearing ability. Only erect on a slant in consultation with the manufacturer
- Compressor install basically rigid .



- Ensure there is sufficient space for maintenance work.
- Ensure there is sufficient ventilation in the machine room.

- Do not operate in a corrosive atmosphere, dust, vapour or flammable environment.

Warning! Compressors are filled with protective gas ex works (approx. 3 bar nitrogen!

- Leave inert gas charge in the compressor up to evacuation.
- **Do not open shutoff valves up to evacuation.**
- **Absolutely avoid entry of air!**

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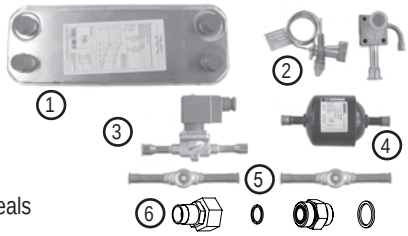
Installation

Installation of the liquid subcooler system (standard version)

Separately enclosed components:

1. Liquid subcooler
2. Expansion valve
3. Solenoid valve
4. Filter drier
5. 2 sight glasses
6. Screw-in sleeve, solder adapter and seals



Please check for completeness of parts before beginning installation.

Observe manufacturer's instructions!

To avoid vibration cracks in the subcooler system, the individual components must be mounted directly to the compressor or installed as a decoupled unit!

Installation

The points listed here represent general guidelines and information on how to pipe and connect the subcooler unit. To perform this work technical knowledge **and skill as well as proof of a hard-soldering test certificate in accordance with** DIN EN 13133 is required.

Pipe connections:

For connections, see dimension diagram page 34-36.

- System design, piping and necessary support points for the individual components must be carefully planned and carried out.
- Properly insulate liquid subcooler against condensation and heating and the related loss of performance.
- For rigidity reasons, the use of stainless steel pipes with a wall of 1 mm is preferred. The pipes must be free of tension during and after soldering to prevent possible breaks lateron.

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Use only suitable hard solder and flux. Solder under an inert gas atmosphere when copper components are to be soldered! The accompanying expansion valve is designed and adjusted for the compressor and the listed refrigerant (sensor charge, nozzle). Only use expansion valves approved and supplied by Bock!

The intermediate pressure line and intermediate pressure chamber are fully insulated at the factory. To mount the expansion valve, cut the insulation as shown in the marked area in ill. 1, page 16. Correct sensor placement is marked by an unpainted area on the pipe.

Installation

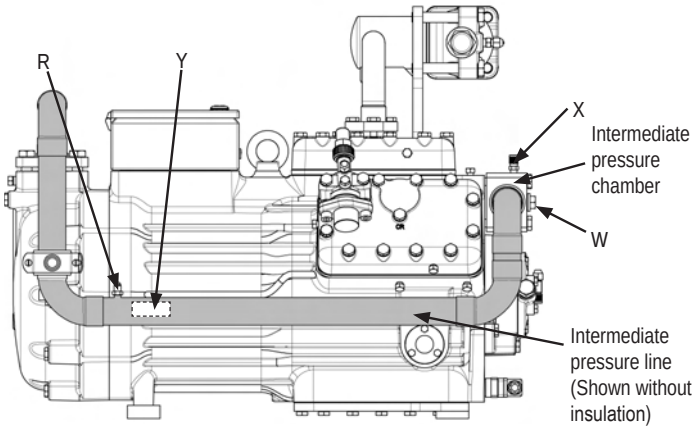

Fig. 1

R	Connection of pressure compensation line for expansion valve	$^{7}/_{16}$" UNF
W	Refrigerant injection connection	M22 x 1,5
X	Schrader connection for intermediate-pressure gauge	$^{7}/_{16}$" UNF
Y	Position of temperature sensor / unpainted	

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Installation

Installation example, liquid subcooler with accessories

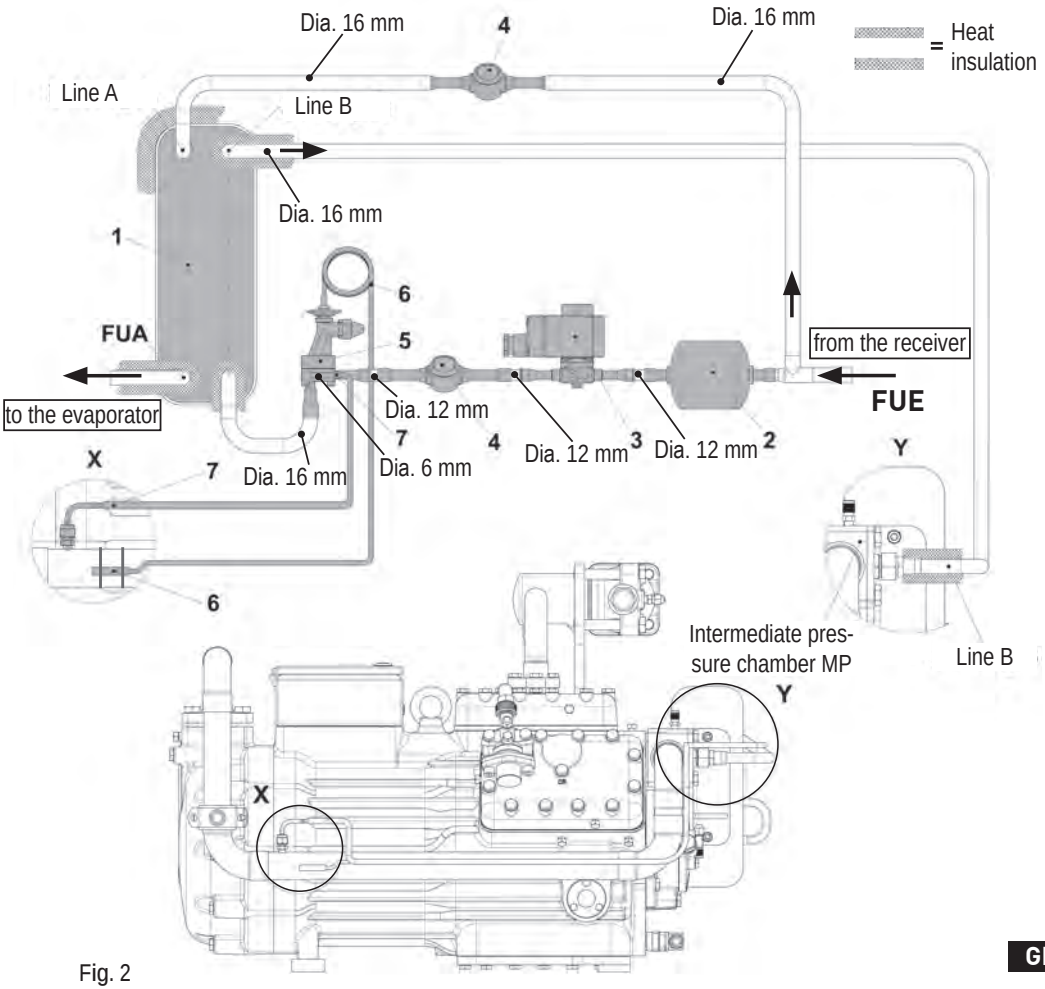

Fig. 2

1 Liquid subcooler	5 Expansion valve	FUA	liquid subcooler, Outlet
2 Filter drier	6 temp. sensor expansion valve		
3 Solenoid valve	7 Pressure compensation connection	FUE	liquid subcooler, Inlet
4 sight glasses			

General notes:

- Sensor lines, wires, etc. should not be attached with cable binders directly to pipes or frames; otherwise, the thin pipes may be worn through. It is better to run them through spiral protective tubes.
- If the compressor will be set up outside, UV-resistant materials should be used.

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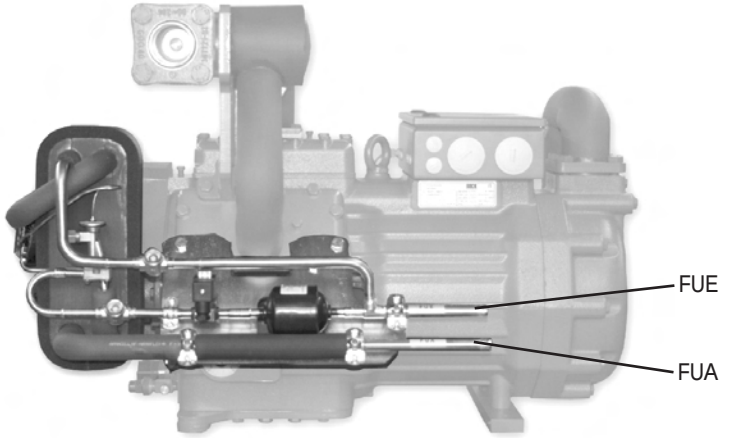
Installation

Factory-installed liquid subcooler system (optional design)

Liquid subcooler, expansion valve, solenoid valve and two sight glasses are mounted directly at the compressor,piped and insulated.



FUE: Liquid subcooler inlet
FUA: Liquid subcooler outlet

Pipe connections

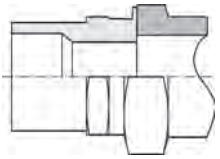


Fig.: schematic

- The **pressure and suction shutoff valves** have graduated inside diameters, so that pipes in the customary millimeter and inch dimensions can be used. The pipe will be immersed more or less deeply according to dimension.
- The connection diameters of the shutoff valves are designed for the maximum compressor output. **The actually required pipe cross-section must be adapted to the actually refrigeration capacity. The same applies for non-return valves.**

Caution when soldering!

- Do not overheat the valve.
- Cool the valve body during and after soldering.
- Remove screw connections from the valve for soldering.

A soldering suppot for tube diameter 54 mm is mounted to the suction shut-off valve of the compressor. A soldering support for tube diameter 2 $^{1}/_{8}$" accompanies the compressor.

GB

Installation

Pipes

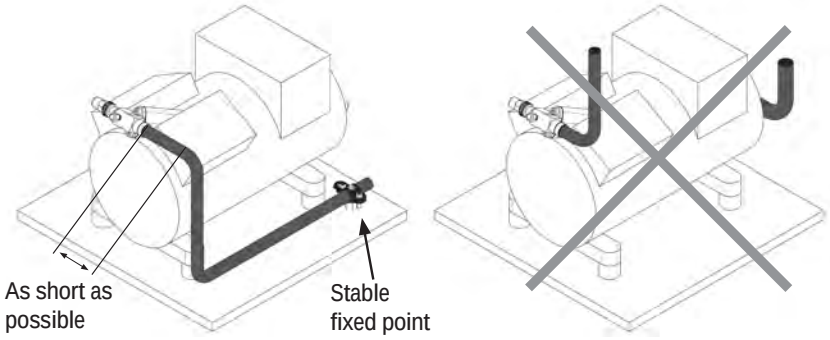
- Pipes and system components must be clean and dry inside and free of scales, metal chippings, and coats of rust and phosphate. Only use hermetically sealed parts.
- Lay pipes correctly. Avoid strong vibrations because of the risk of cracks and breaks. Provide suitable fixed points and/or vibration compensators as required.
- Guarantee a correct oil return.
- Keep pressure losses to an absolute minimum.

Laying suction and discharge line

A proper run of the suction and discharge line immediately after the compressor is of great importance for the system's smooth running and freedom from vibration.

Improperly installed pipes can cause cracks and tears, which result in refrigerant loss.

A rule of thumb:
Always lay the first pipe section starting from the compressor downward and parallel to the drive shaft.



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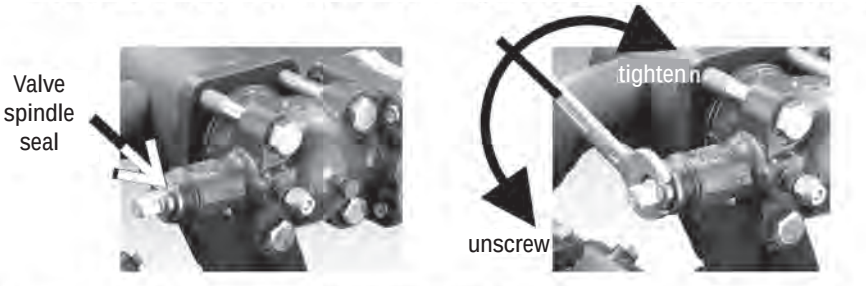
Installation

Shut-off valves

Warning! Comply with the safety instructions on page 14

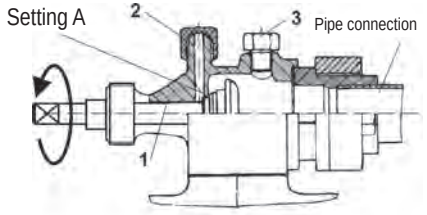
Before opening or closing the shut-off valve, turn the valve spindle seal approx. ¼ of a turn counter-clockwise. After activating the shut-off valve, tighten the valve spindle seal again clockwise.



Mode of operation of the screw-down service connections

Opening the shut-off valve
Open spindle 1 turning to the left (counter-clockwise) as far as it will go.

Shut-off valve is fully open / service connection 2 closed (setting A).



Opening the service connection (2)
Turn spindle 1 approx. ½ to 1 turn to the right (clockwise)

Service connection 2 is now open, the shut-off valve is also open (setting B).

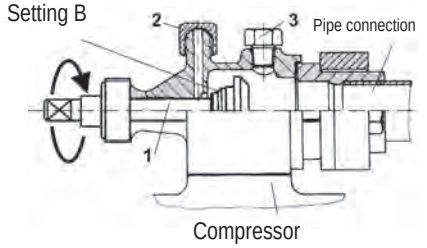


Fig.: schematic

Connection 3 is intended for safeguard systems and cannot be shut-off.

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Electrical system

Electrical connection

Warning! High voltage! Perform work only with the electrical installation disconnected from the power supply!

- Make connection of the compressor motor according to the circuit diagram (see inside of terminal box). Comply with local safety regulations for electrical work and the safety standards EN 60204, EN 60335 when connecting.
- For cable lead-through at the terminal box use suitable cable screw connections in correct protective version (see name plate). Use strain relief. Avoid abrasion points on cables.
- Motor contactors, feed lines and fuses are to be rated according to the maximum operating current (see compressor nameplate).
- Compare the details for voltage and frequency on the nameplate with the details for the electricity mains supply. The motor may only be connected up when these details correspond.

Connection of the drive motor

The compressor is equipped with a motor in direct or part-winding design

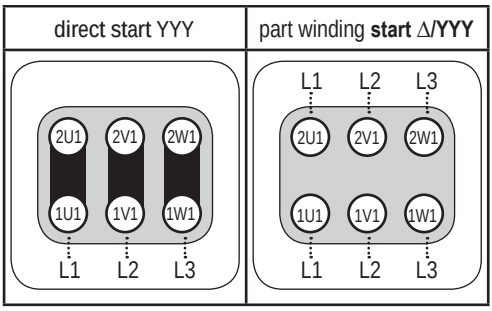
Designation on the name plate	Designation on the terminal box
Δ / YYY	

Compressors marked in this way are suitable for direct or part winding start. The motor winding is divided into two parts: part winding 1 = 60% and part winding 2 = 40%. This winding division reduces the start-up current during a part winding start to approx. 65% of the value for a direct start.

Mechanical start unloader with bypass solenoid is not required.

When testing the winding with resistance meter, please note that part winding 1 and part winding 2 are internally connected.

In the factory, the motor is connected for direct starting (YYY). For part winding start (Δ/YYY) remove the bridges and connect the motor feed cable according to the circuit diagram:



GB

Electrical system

WARNING!
Failure to comply results in reversed fields of rotation and can cause motor damage. After the motor has started up with part winding 1, part winding 2 must be switched on after max. 1 second delay. Failure to comply can be detrimental to the service life of the motor.

Mainline circuit diagram for part-winding start

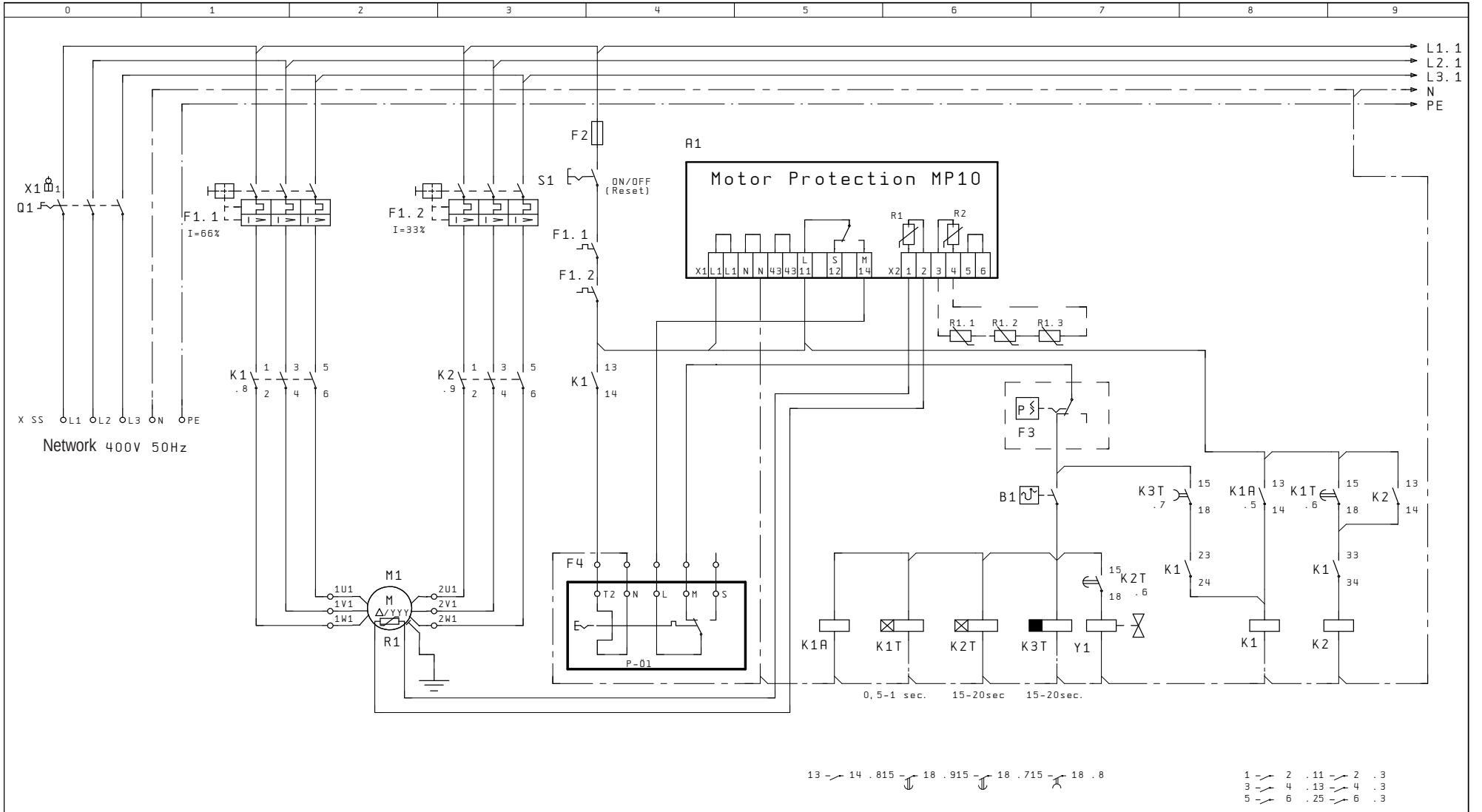
CAUTION!
Ensure that power is supplied via K1 to winding 1 (60 %) (1U1 / 1V1 / 1W1) and via K2 to winding 2 (40 %) (2U1 / 2V1 / 2W1). The motor contactors (K1 / K2) are each to be rated for approx. 70% of the max. operating current.

A1 Electronic trigger MP10
Q1 Main switch
F1.1 Motor protection switch (part winding 1)
F1.2 Motor protection switch (part winding 2)
F2 Fuse control current circuit
F3 Safety chain (high/low pressure monitoring)
F4 Oil differential pressure switch

S1 Switch control voltage
B1 Release switch (thermostat)

K1 Mains contactor (part winding 1)
K1A Auxiliary contactor
K2 Mains contactor (part winding 2)
K1T Delay relay max. 1 s (slow release), part winding 2
K2T Delay relay max. 20 s (slow release),
Open solenoid Y1 (supcooler)
K3T Delay relay max. 20 s (slow release),
compresssor switch-off (suction subcooler)
Y1 Solenoid valve intermediate cooler
M1 Compressor motor

R1 PTC sensor
R1.1 Heat protection thermostat (PTC sensor)
R1.2 Heat protection thermostat (PTC sensor)
R1.3 Heat protection thermostat (PTC sensor)
R3 Oil temperature (NTC sensor)



			Datum	13. Feb. 2007			HGZ7 mit MP10		
			Bearb.	Kelich					
			Gepr.	11. Feb. 2008				BOCK COMPRESSORS	Bl. 1
Änderung	Datum	Name	Norm		Urspr.	Ers. f.	Ers. d.		1 Bl.

Electrical system

Electronic trigger MP 10

The compressor motor and the high pressure side of the compressor are equipped with posistor temperature sensors (PTC). The temperature sensors are wired to the electronic trigger MP 10 in the terminal box. In the event of overtemperature in the motor winding or on the hot gas side of the high pressure stage, the unit switches the compressor off and the corresponding LEDs H1 or H2 light up.

When the device has triggered, this indicates an overload or intolerable operating conditions. Ascertain and eliminate the cause.

The device has a reclosure preventing feature. After eliminating the fault, the device is quit by interrupting the mains power with the external alarm reset switch S1 (see main-line wiring diagram). The reclosure preventing feature is unlocked and LEDs H1 or H2 go off again.

Connection of the electronic trigger MP 10

The electrical connection of MP 10 is to be completed according to the circuit diagram. The trigger is to be protected with a fuse (F) of max. 4 A, slow-acting. To guarantee the protection function, the electronic trigger is mounted as first element in the control power circuit.

Connections temperature monitoring:

- motor winding: terminals 1- 2
- hot gas side: terminals 3- 4

WARNING! Terminals 1 - 6 on the electronic trigger MP 10 and terminals PTC 1 and PTC 2 on the compressor terminal board may not come into contact with mains voltage. This would destroy the electronic trigger and the PTC sensors.

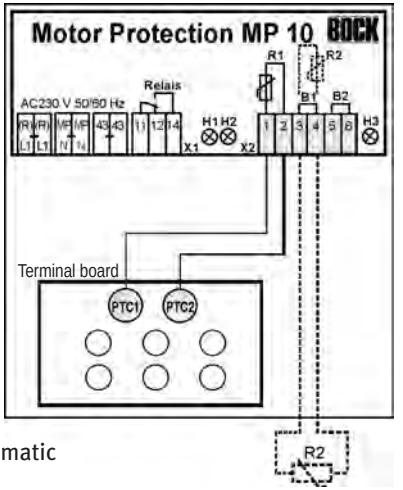


Fig.: schematic

GB

Electrical system

Function test of the electronic trigger MP 10

Before starting up and after any faults or changes to the control power circuit of the machine, check the electronic trigger to ensure that it functions properly:

Pos	Procedure	LED H1 red	LED H2 red	LED H3 green
1	● **Interrupt the power supply (L1 or S1)** ● Disconnect the motor temperature sensor connection (terminal 1 or 2) ● Disconnect the hot gas temperature sensor (if installed) (terminal 3 or 4)	**OFF**	**OFF**	**OFF**
2	● **Switch the power supply on again (L1 or S1).** ● Function check motor temperature sensor: stand-by ● Function check hot gas temperature sensor: stand-by	**ON**	**ON**	**ON**
3	● **Interrupt mains voltage again (L1 or S1)** ● Connect terminals 1 or 2 respectively 3 or 4 again	**OFF**	**OFF**	**OFF**
4	● **Switch the power supply on again (L1 or S1):** ● MP 10 in stand-by mode	**OFF**	**OFF**	**ON**

The compressor and the motor protection unit MP10 are ready for use if the LED control lamps signal perfect operating functions.

Information for contactor and motor contactor selection

All protection equipment, switching and monitoring devices must comply with the local safety regulations and established specifications (e.g. VDE) and regulations as well as the manufacturer's specifications. Use motor protector switch! Motor contactors, feed lines and fuses are to be rated according to the maximum operating current (see name plate). A max. 7 times the permissible operating current according to the compressor name plate is set as the short circuit triggering current.

Attention! Always install all electrical peripheral devices in an external control cabinet outside the explosion-endangered area!

Electrical system

Oil sump heating

When the compressor is at a standstill, refrigerant diffuses into the lubrication oil of the compressor housing, depending on pressure and ambient temperature. This reduces the lubrication capacity of the oil. When the compressor starts up, the refrigerant contained in the oil evaporates out through the reduction in pressure. The consepuences can be foaming and migration of the oil, causing oil shocks under certain circumstances.

In order to avoid damage to the compressor, the compressor is equipped with an oil sump heater as a standart feature. The oil sump heater should always be connected up and operated.

Operation: The oil sump heater operates when the compressor is at a standstill. When the compressor starts up, the oil sump heating switches off.

Connection: The oil sump heater must be connected via an auxiliary contact (or parallel wired auxiliary contact) of the compressor contactor to a separate electric circuit.
El. data: 230 V - 1 - 50/60 Hz, 140 W

WARNING! The oil sump heater must not be connected to the electrical circuit of the safety control chain..

Start-up

Preparations for Initial commissioning

The compressor has undergone trials in the factory and all functions have been tested. There are therefore no special running-in instructions.

Before starting up, check the compressor for any signs of transport damage!

To protect the compressor from intolerable operating conditions, high- and low-pressure pressostats. Comply with the accident prevention regulations!

GB

Pressure strength test

The compressor was tested in the factory for pressure strength. If the entire plant should be subjected in addition to a pressure strength test, then observe the following:

- Test the cold circuit according to EN 378-2 (or a corresponding safety standard).
- Perform the pressure strength test preferably with dry nitrogen.
- Under no circumstances press off the compressor with air.
- Do not mix any refrigerant with the testing medium, since otherwise shifting the ignition limit into the critical range is possible.

Danger! The maximum permissible operating pressure of the compressor may not be exceeded during the entire testing process (see name plate information)!

Start-up

Tightness test

- Perform the tightness test of the refrigeration plant according to EN 378-2 (or a corresponding safety standard) without inclusion of the compressor (preferably dried with N2).
- Do not add any refrigerant to the testing medium since otherwise shifting the ignition limit into the critical range is possible.

Evacuation

- Firstly evacuate the plant, then include the compressor in the evacuation process.
  - Pressure relieve the compressor
  - Open suction and pressure shutoff valve.
  - Evacuate with the vacuum pump on the suction and high pressure side.
  - Vacuum < 1.5 mbar with shutoff pump.
  - Repeat the process several times if necessary.

In addition to the suction or high pressure side, the intermediate pressure area of **the compressor must also be evacuated (Use connection X, see fig. 1, p. 16). The solenoid valve of the subcooling system (p. 17, fig. 2, item 3) must be opened.**

WARNING! Do not start the compressor in vacuum. Apply no voltage – also not for test purposes (may be operated only with refrigerant).
In the vacuum the spark-over and creepage current distances of the terminal board connection bolts shorten, this can lead to winding and terminal board damage.

Filling with refrigerant

Caution! Wear personal safety gear!

- Check that the compressor suction and discharge shut-off valves are open.
- With the compressor switched off, fill the liquid refrigerant directly into the condenser or receiver, breaking the vacuum.
- **Pay attention to adequate refrigerant fill before starting up the compressor.** During operation, refrigerant must be free of bubbles in sight glasses 1 and 2 of the liquid subcooler.
- If the refrigerant needs topping up after starting the compressor, it can be topped up in vapour form on the suction side, or, taking suitable precautions, also in liquid form at the inlet to the evaporator.

- Avoid overfilling the machine with refrigerant.
- To avoid shifts in concentration, zeotropic refrigerant blends (e.g. R407C) must always only be filled into the refrigerating system in liquid form
- Warning! Do not fill liquid refrigerant into the suction shut-off valve on the compressor.
- Do not mix additives with the oil and refrigerant.

Start-up

Start-up

Warning! Open pressure and suction shutoff valves before starting the compressor!

- Check that the safety and protection devices (pressure switch, motor protection, electrical contact protection measures etc.) are all functioning.
- Switch the compressor on
- Check the oil level in the compressor. It must be visible in the sight glass.

Caution! If larger quantities of oil have to be refilled, there is a risk of oil liquid shocks. In this case, the oil return has to be checked.

- On reaching equilibrium (constant operating conditions), check that the system maintains the permitted operating conditions.
- When the whole system is running perfectly, we recommend drawing up a final protocol stating all important data and measured values.

Liquid sluggings

WARNING! Liquid slugging can cause damage to the compressor and leakage of refrigerant.

To avoid liquid slugging, the following points should be observed:

- The whole plant must be properly designed.
- All components must be rated to be compatible with each other with regard to output (particularly evaporator and expansion valve).
- Suction gas overheating at the compressor entrance should be min. 7 - 10 K (check setting of the expansion valve).
- The machine must reach a state of equilibrium.
- When selecting the evaporator expansion valve, pay attention to correction factors for liquid subcooling.
- Avoid transfer of refrigerant into the compressor when the system is at a standstill.
- The use of a liquid separator is recommended.

To avoid liquid shocks on the HP stage, the expansion valve may only be opened approx. 15-20 seconds after the compressor is switched on (full load operation).

At compressor shut-down:
Close the solenoid valve approx. 15 - 20 seconds before the compressor is switched off.

GB

Maintenance

Safety instructions

Before starting any work on the compressor:

- Switch the machine off and secure it against being switched back on.
- Relieve machine from the system pressure.

After maintenance has been performed:

- Connect safety switch.
- Evacuate compressor.
- Cancel switch-on blockage.

Avoid entry of air into the plant!
Ester oil behaves very strongly hygroscopically. The humidity bonded in the oil cannot be removed sufficiently by the evacuation process. Therefore very careful handling is required!

To guarantee optimum operating safety and life of the compressor, we recommend performing service and checking work at regular intervals of time:

- Oil change
  - In series plants produced in the factory not mandatory.
  - In field installations or operating in the application limit area: for the first time after 100 to 200 operating hours, then approx. every 3 years or 10,000 – 12,000 operating hours. Dispose of old oil according to the regulations, observe national regulations.
- Regular checks: Tightness, running noise, pressures, temperatures, function of the additional equipment such as oil sump heater, pressure switches: annually. Observe national regulations.

Spare part recommendation

HGZ7 / ...	1620-4	1860-4	2110-4
Designation	Art.-Nr.		
set gaskets	80197		
set valve plate low pressure side LP	80193		
set valve plate high pressure side HP	80194		
set Oil pump	80116		
set Oil sump heater	08426		

GB

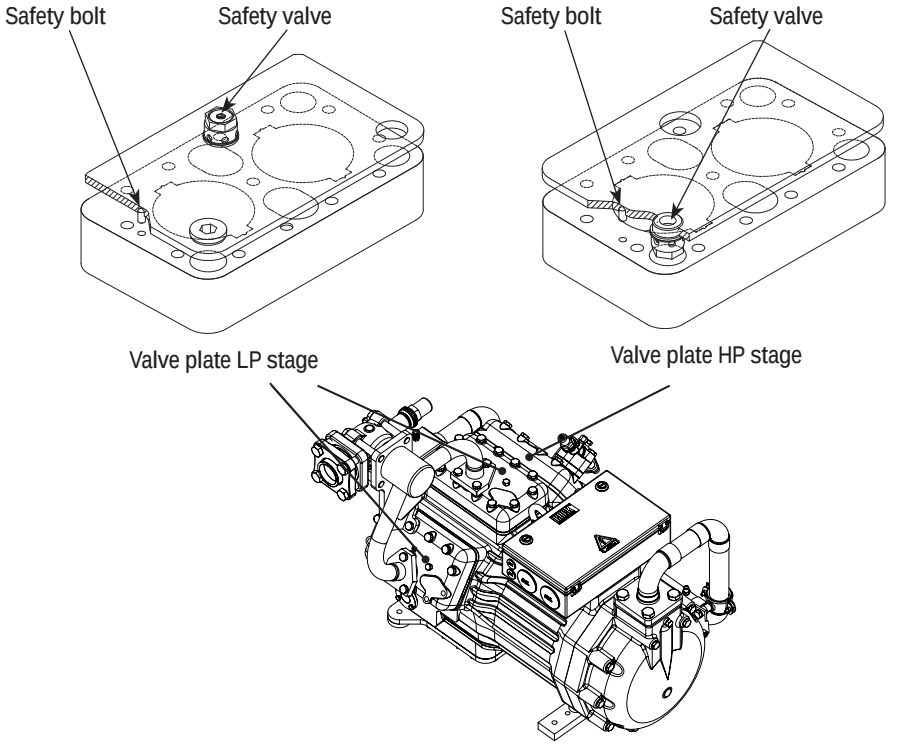
Maintenance

Replacing the valve plates

The compressors are divided into an LP and an HP compressor stage. Different valve plate designs are required because of the different ducts in the individual compressor stages.

The valve plates have been fitted with safety bolts to prevent any confusion.
The safety bolts engage in the corresponding bores on the cylinder heads, the safety bolts must not be removed!

Installation of the valve plates:



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Maintenance

Screwed unions

Various installation, maintenance and servicing work entails intervention in the compressor. All work must therefore be performed with strict compliance with the given safety instructions. The following torques must be used when re-assembling the compressor

Connecting rod screws	M 6	15 Nm
Oil drain plug, oil filler plug, oil sump heating	M 22 x 1,5	100 Nm
Sight glass, connection oil level controller	M 6	15 Nm
Flange connection,	$^{7}/_{16}$"	13 Nm
soldered connection shut-off valves	M 10	60 Nm
Plug screws, bungs, valve bodies	AL-, LR-plug:	100 Nm
	$^{1}/_{8}$" NPTF	25 Nm
Live connections	M 6	3 Nm
Rotor	M 12	65 Nm

Notes: Cylinder head/valve plate: tighten screws from the middle outwards crosswise in at least two stages (torque 50/100 %)

Excerpt from the lubricant table

The oil grade filled as standard in the factory is noted on the name plate. This oil grade should be used preferably. Alternatives to this are listed in the following excerpt from our lubricant table.

Lubricants

Bock series oil grades	Recommended alternatives	
For HCFCs (R22)		
FUCHS Reniso SP 46	FUCHS Reniso, z.B. KM, HP, SP 32	
	SHELL Clavus SD 22-12	TEXACO Capella WF 46
	SUNOIL Suniso 3GS	
For HFCs (R404A/R507, R410A)		
FUCHS Reniso Triton SE 55	FUCHS Reniso Triton SEZ 32	MOBIL Arctic EAL 32
	ICI Emkarate RL 32 H, S	SHELL Clavus R 32

Refer to the Bock lubricant tables for information about further suitable oils.

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Decommissioning

For major repairs or when decommissioning:

Comply with the safety instructions on page 29! Close the shut-off valve on the compressor, vacuum out the refrigerant (do not blow out!) and dispose of correctly. Open the screwed unions or flanges at the compressor valves and remove the compressor using hoisting gear if necessary. When scrapping the compressor, drain the oil and dispose of correctly. Comply with the national regulations!

WARNING! Compressor is under pressure! Avoid injures to skin and eyes. Wear goggles!

Accessories

Heat protection thermostat

If desired, the compressor is equipped with a thermal protection thermostat (PTC resistor). It protects the compressor from unacceptably high pressure gas temperatures. The thermal protection thermostat is mounted on the hot gas side of the compressor at the cylinder head and connected to the MP 10 trigger unit.

Switching points:

Switch-off temperature:	approx. 145°C ± 5 K
Switch-back-on temperature:	approx. 130°C

MP 54 oil pressure switch (add-on kit, art. no. 08920)

230 V -1- 50/60 Hz, IP 20

If installed at the factory, the switch is mounted directly to the compressor and piped. The electrical connection must be made in accordance with the accompanying description. If a retrofit, the switch is supplied with the corresponding fastening bracket and connection tubes. The oil pump cover is equipped to permit screwing on of oil pressure difference sensors.

Oil differential pressure sensor (Δp switch Kriwan make)

220-240 V - 1 - 50/60 Hz

Oil pressure monitoring ensures a reliable and secure oil supply. The device simultaneously measures both the suction and high pressure of the oil pump.

Technical data

Type	Number of cylinders	Swept volume 50 Hz (1450 1/min) LP	Swept volume 50 Hz (1450 1/min) HP	Swept volume 60 Hz (1740 1/min) LP	Swept volume 60 Hz (1740 1/min) HP	Electrical data ③ Voltage ①	Max. working current ②	Max. power consumption ②	Starting current (rotor locked)	Weight 2)	Connections 1) Discharge line DV	Connections 1) Suction line SV	Oil charge
		m³/h		m³/h			A	kW	A	kg	mm (inch)	mm (inch)	Ltr.
							*PW 1+2		*PW1/PW 1+2				
HGZ7/1620 - 4	6	93,7	46,9	112,5	56,2	④	50	27,0	185/278	294	35 (1 3/8)	54 (2 1/8)	4,8
HGZ7/1860 - 4		107,6	53,8	129,1	64,6	④	55	30,0	185/278	291			
HGZ7/2110 - 4		122,4	61,2	146,9	73,5	④	65	36,0	191/286	288			

* PW = Part Winding, motors for part winding starting
1 = 1. part winding, 2 = 2. part winding

1) for soldering joint 2) in standard design

LP = Low pressure stage HP = High pressure stage

Oil sump heater: 230V -1- 50/60 Hz 140 W

① Tolerance (±10%) relates to the mean value of the voltage range

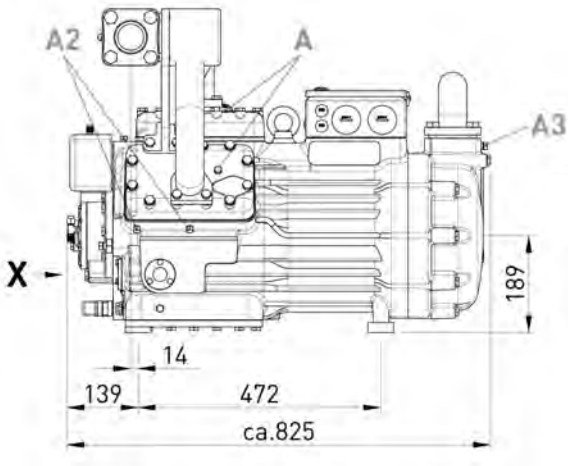
② Take account of the max. operating current / max. power consumption when designing contactors, leads and fuses.

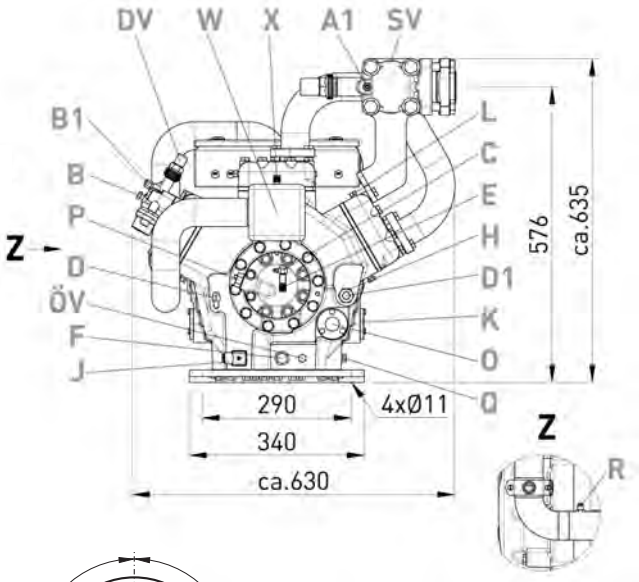
③ All data are based on voltage rms values

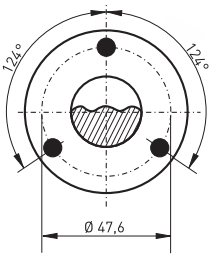
④ 380-420 V Δ/YYY -3- 50 Hz PW, 440-480 V Δ/YYY -3- 60 Hz PW
> Winding ratios: 60% / 40 %

Dimensions and connections

Compressor in standard design. Intermediate pressure mixed line mounted and insulated.
(Liquid subcooler with accessories as an extra item)







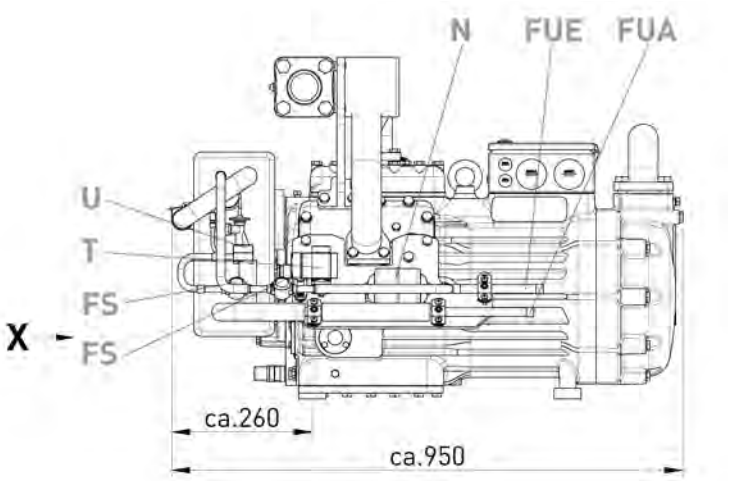
View X:
Connection possibility for oil level regulator

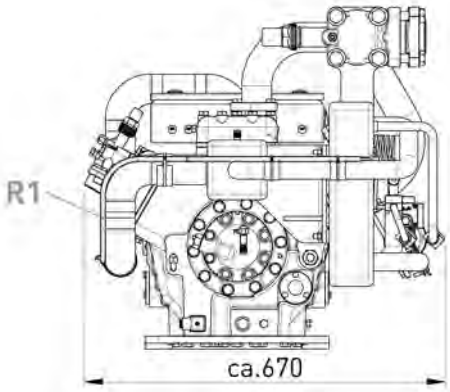
Three-hold connector for oil level regulator
Products ESK, AC+R, CARLY (3x M6, 10 deep)

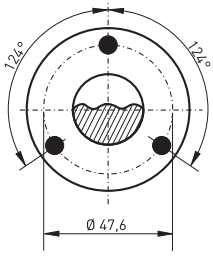
GB

Dimensions and connections

Compressor in optional design.
(Liquid subcooler with accessories attached directly to the compressor)







View X:
Connection possibility for oil level regulator

Three-hold connector for oil level regulator
Products ESK, AC+R, CARLY (3x M6, 10 deep)

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SV DV	Suction line Discharge line Please refer to technical data, page 33	
FUE	Liquid subcooler ON	Ø 16 mm - $^{5}/_{8}$"
FUA	Liquid subcooler OFF	Ø 16 mm - $^{5}/_{8}$"
A	Connection suction side, not lockable	$^{1}/_{8}$" NPTF
A1	Connection suction side, lockable	$^{7}/_{16}$" UNF
A2	Connection intermediate pressure, not lockable	$^{1}/_{8}$" NPTF
A3	Connection intermediate pressure, not lockable	$^{1}/_{4}$" NPTF
B	Connection discharge side, not lockable	$^{1}/_{8}$" NPTF
B1	Connection discharge side, lockable	$^{7}/_{16}$" UNF
C	Connection oil pressure safety switch OIL	$^{7}/_{16}$" UNF
D	Connection oil pressure safety switch LP	$^{7}/_{16}$" UNF
D1	Connection oil return from oil separator	$^{1}/_{4}$" NPTF
E	Connection oil pressure gauge	$^{7}/_{16}$" UNF
F	Oil drain	M22 x 1,5
FS	Sight glass liquid line	Ø 12 mm
H	Oil charge plug	M22 x 1,5
J	Oil sump heater	M22 x 1,5
K	Sight glass	3 hole M6
L	Connection thermal protection thermostat	$^{1}/_{8}$" NPTF
N	Filter drier	Ø 12 mm
O	Connection oil level regulator	see view X
ÖV	Oil service valve connection	$^{1}/_{4}$" NPTF
P	Connection oil pressure differential sensor	M20 x 1,5
Q	Connection oil temperature sensor	$^{1}/_{8}$" NPTF
R	Connection of pressure compensation line for expansion valve	$^{7}/_{16}$" UNF
R1	Pressure compensation line for expansion valve	Ø 6 mm
T	Solenoid valve	Ø 12 mm
U	expansion valve - refrigerant-dependent	Ø 12 mm
W	Connection refrigerant injection	M22 x 1,5
X	Connection for Schrader valve for intermediate pressure manometer	$^{7}/_{16}$" UNF

DECLARATION OF CONFORMITY CE 96
for use of the compressors within the European Union
(as per EU low voltage directive 73/23/EEC, in the version 93/68/EEC)

We herewith declare that the hermetic refrigerating compressors named in the title comply with the low voltage directive 73/23/EEC in the version 93/68/EEC.

Applied harmonised standard

EN 60335-2-34

When installing our products in a machine,
the following manufacturer declaration must be taken into consideration.

MANUFACTURER DECLARATION
for use of the compressors within the European Union
(refering to the EU machinery directive 98/37/EEC, annex II B)

We herewith declare that the hermetic refrigerating compressors named in the title in the version supplied by us are intended for installation in a machine which complies with the machinery directive 98/37/EEC.

Applied harmonised standards

EN ISO 12100-1	EN 349	EN 60529
EN ISO 12100-2	EN 60204-1	

It is however not permitted to start up our products before the machine in which they are integrated has been tested according to the corresponding statutory regulations and declared to be conforming in all points.

Frickenhausen, 27.11.2006

Dr. Harald Kaiser
Technical Director

PED CLASSIFICATION

(as per EU Pressure Equipment Directive 97/23/EC)

DECLARATION OF CONFORMITY
for use of the compressors within the European Union
(as per EU Pressure Equipment Directive 97/23/EC)

We hereby declare that piping of the refrigerant compressors

HGZX7/2110-4 R404A/R507, HGZX7/2110-4 R410A and HGZ7/2110-4 R22

agrees with the Pressure Equipment Directive 97/23/EG dated 29 May 1997.

Valid for Category I piping
Evaluation procedure module A

The other parts of the piping fall under article 3§3 of the
Guideline and correspond to good engineering practice

MANUFACTURER DECLARATION
for use of the compressors within the European Union
(as per EU Pressure Equipment Directive 97/23/EC)

We hereby declare that piping of the refrigerant compressors

HGZX7/1620-4 R404A/R507, HGZX7/1620-4 R410A, HGZ7/1620-4 R22
HGZX7/1860-4 R404A/R507, HGZX7/1860-4 R410A and HGZ7/1860-4 R22

agrees with the Pressure Equipment Directive 97/23/EG dated 29 May 1997.

GB

Vallid for piping corresponding to article 3§3

Dr. Harald Kaiser
Technischer Leiter

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